NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 50 Number 2, December 2019. Pp.183-187
Available online at: http://www.ajol.info/index.php/naj

EVALUATION OF FUNCTIONAL AND SENSORY QUALITIES OF COOKIES FROM COCOYAM-WHEAT COMPOSITE FLOURS FOR UTILIZATION

***[1]Nwadili, V.U., [1]Omodamiro, R.M., [1]Etudaiye, H.A., [1]Kanu, N.A. and [2]Ochida, C.O**
[1]National Root Crops Research Institute, Umudike, Abia State Nigeria
[2]Centre for Food Technology and Research, Benue State University, Makurdi, Nigeria
*Corresponding Authors' email: vickyezigbo@yahoo.com

ABSTRACT
Cookies were produced from blends of fermented and unfermented cocoyam-wheat composite flours at 0; 25; 50; 75 and 100 percentage inclusion levels respectively and functional properties of the flour blends and the sensory quality of the cookies determined. The functional properties of the flour studied were bulk density, swelling index, water absorption capacity, oil absorption capacity and gelation temperature while the sensory attributes included colour, taste, crispness and general acceptability. Results obtained revealed that fermentation reduced the bulk density of the 100% cocoyam flours. Significant differences were found in swelling index at all inclusion levels for both fermented and unfermented flours. Sensory properties of cookies made from the cocoyam-wheat composite flours revealed that up to 50% inclusion of fermented and unfermented cocoyam flour to wheat flour gave acceptable results in terms of taste, colour and crispiness The results of this finding paves way for enhanced utilization of cocoyam-wheat composite flour for the production of cookies.

Keywords: Fermented, Unfermented, Functional, and Sensory properties

Introduction

Cookies represent a category of snacks largely accepted throughout the world and also widely consumed (Lorenz 1983).They offer a valuable supplementation for nutritional improvement for both the young and elderly people due to their affordable price, convenience, shelf-stability, and nutritive value. Cocoyams (*Colocasia* and *Xanthosoma* spp) are important local staples in Nigeria. They have better nutritional qualities than other root and tuber crops such as cassava and yam, with higher protein, vitamin and mineral content. Processing cocoyam into flour for baking, baby food formula and other cocoyam recipes are recommended to reduce post-harvest losses of cocoyam and hence increase its utilization (Oti and Akobundu, 2005; Aniedu and Oti, 2008; Agbelomoge, 2013). The production of cookies with cocoyam would increase cocoyam production, consumption and also promote its utilization (Igbabul et al., 2015; Anankware et al., 2018). This study was therefore carried out to evaluate the effects of the varying proportions of fermented and unfermented cocoyam-wheat composite flour on the functional properties of the flours and the acceptability of cookies made from the flours.

Materials and Methods

Wheat flour was purchased from Umuahia Main market, Abia State, Nigeria, while freshly harvested cocoyams were obtained from the multiplication farm of the Cocoyam Programme of the National Root Crops Research Institute, Umudike, Abia State; then taken to the Product Development Programme laboratory, National Root Crops Research Institute, Umudike, Abia State where they were processed into flour. Processing of cocoyam into flour started within 60 minutes after harvest.

Cocoyam flour Processing

The cocoyam samples were processed into flour (fermented and unfermented) using the method of Onimawo and Egbekun (1998) with a slight modification. As shown in Figure 1, the unit and sub-unit operations employed in the preparation of the cocoyam flour include; sorting, peeling, washing, chipping, soaking and drying. In the process of preparing the cocoyam flour samples, peeling was done manually with kitchen knife while chipping was done mechanically with a chipping machine (Crypto Peerless, Birmingham, England) which produced chips of approximately 4mm thickness. The chips were washed with potable water and were divided into two equal parts. One part of the chips was oven-dried at 65ºC for 9h until crispy. The other part was soaked in portable water for 24h. The fermented chips were drained and oven-dried at 65ºC for 9h until crispy. The dried samples were subsequently milled into flour in laboratory hammer mill. The flour products were packaged in sealed polyethylene bags until required for analysis.

Sample Formulation

The wheat flour was sieved using 100μm mesh sieve to obtain uniform particle size and mixed with the cocoyam in the proportions shown in Table 1. Mixing was achieved with the use of Kenwood mixer at speed 6 for 3 minutes to obtain uniform blending. Fermented and unfermented cocoyam flours were blended with wheat flour at the following ratios; 0:100; 25:75; 50:50; 75:25 and 100:0% to obtain fermented and unfermented cocoyam-wheat flour composites which were used to produce cocoyam-wheat cookies.

Preparation of Cocoyam-Wheat Cookies

The cookies were baked using the method of Aniedu and Oti (2008). Cookies were prepared using cocoyam-wheat composite flours at different levels of substitution.

Determination of functional Properties of Cocoyam-Wheat composites flour

Bulk density and swelling index, were determined using AOAC (2000) methods while water and oil absorption capacities were determined according to the methods described by Onimawo and Akubor (2005).

Sensory Evaluation of Cookies Samples

Randomly selected twenty semi-trained panellists (who were regular consumers of cookies) comprising of staff of National Root Crops Research Institute Umudike and students of the College of Applied Food Science and Tourism, Michael Okpara University of Agriculture, Umudike were used to assess the sensory quality of the cookies samples. In the sensory evaluation, samples were scored based on the following attributes: taste, crispiness, colour and general acceptability on a 9-point hedonic scale with 1 representing dislike extremely, 5, neither like nor dislike and 9 like extremely (Ihekoronye and Ngoddy, 1985).

Statistical Analysis

All data obtained from the studies were analyzed using one factor analysis of variance (ANOVA) and Turkey mean separation for multiple comparisons with the Statistical Analysis System (SAS) program SAS Institute, (2003). Significance was accepted at $p \leq 0.05$.

Results and Discussion

Functional properties of Cocoyam- Wheat Composite flours

The functional properties of the cocoyam-wheat composite flours are presented in Table 2. The results revealed that the bulk densities of 100% fermented and unfermented cocoyam flours were 0.46g/cm^3 and 0.53g/cm^3 respectively. These values were lower than the bulk density value (0.62g/cm^3) obtained for 100% wheat flour as shown in Table 2. This might be because particle size and the true density of flours are generally affected by bulk density. Cocoyams are known to have a high content of tiny, easily digestible, starch grains (Adane *et al*., 2006). Significant differences ($p \leq 0.05$) were recorded in the bulk density values of the composite flours as shown in Table 2. Results further showed that 25% and 50% inclusion of fermented cocoyam flour to wheat flour increased bulk density values of the composite flours to 0.54g/cm^3 and 0.60g/cm^3 respectively but at 75% inclusion of fermented cocoyam flour to wheat flour, there was a decrease in bulk density value of 0.43g/cm^3 of the composite flour. Bulk density of flour is important in determining the packaging requirement as it gives an indication of the relative volume and type of packaging material required (Karuna *et al*., 1996; Udensi and Okoronkwo, 2006; Kulkarni *et al.,* 2008). Low bulk density of flour is important and determines storability and transportation.

Water absorption capacity values of the fermented cocoyam-wheat composite flours varied from 1.45g/ml to 2.0g/ml while for the unfermented cocoyam-wheat composite flours values varied from 1.40g/ml to 2.75g/ml. Water absorption capacity is an important processing parameter in the development of ready-to-eat foods; high absorption capacity assures product cohesiveness (Houson and Ayenor, 2002). Oil absorption capacity of the fermented cocoyam-wheat composite flours fell within the range of 1.15 g/ml to 1.75 g/ml while the unfermented cocoyam-wheat composite flours had oil absorption capacities values in the range of 1.25g/ml to 2.25g/ml. Oil absorption capacity is of great importance since fat as a flavor retainer increases the mouth feel of foods (Anankware *et al*., 2018).

Swelling index (SI) is a quality criterion in some good formulation such as bakery products; it indicates the amount of water that can be absorbed by the flour granules during heating (Osungbaro *et al.,* 2010). The results showed that 100% fermented and unfermented cocoyam flours had higher swelling index values of 1.82 and 1.90 while the swelling index value for 100% wheat flour was 1.2 (Table 2). There were significant differences in the swelling index values of the fermented cocoyam-wheat composite flours. Increase in the percentage inclusion of fermented cocoyam flour (25%; 50% and 75%) to wheat flour significantly increased the swelling index values of the composite flours (1.20; 1.33 and 1.59) respectively. This same trend was observed for the unfermented cocoyam-wheat composite flours. Significant differences ($p<0.05$) were observed in gelation temperature values. The 100% wheat flour recorded the highest gelation temperature of 81˚C while the 100% fermented and unfermented cocoyam flours recorded the lowest gelation temperature values of 76˚C and 74.5˚C respectively.

Sensory properties of cookies from Cocoyam-Wheat Composite flours

The sensory scores of cookies prepared from 100% wheat flour and composite flours of cocoyam (fermented and unfermented) and wheat are presented in Table 3. The result showed that cookies from 100% wheat flour obtained the highest likeness values in all the analysed attributes: taste, crispiness, colour, and overall acceptability. This is in agreement with the report of Anankware, *et al*., (2018) who observed highest likeness in all the attributes of cookies produced from 100% wheat flour compared to those with cocoyam flour substitution. The sensory scores for taste of cookies from the fermented cocoyam-wheat composite flour vary from 5.40-7.40 with the cookies from the 100% wheat flour having the highest score of 7.40 and the cookies from the 100% fermented cocoyam flour having the lowest value of 5.40. In terms of colour, cookies from 100% wheat flour had higher values of 7.80 and 7.75, while cookies from 100% fermented and unfermented flours had the lowest values of 5.3 and 4.15 respectively. As can be observed for the overall acceptability scores, there was no significant difference ($p<0.05$) between the cookies from flours with varied ratios of cocoyam-wheat composites for both fermented and unfermented cocoyam flours. All the cookies prepared from 100% wheat flour and the composite flours were generally accepted as all the scores were higher than five which is the minimum acceptable value on the nine-point hedonic scale.

Conclusion

The study shows that up to75% inclusion of both fermented and unfermented cocoyam flour to wheat flour gave the least bulk density values of 0.43g/cm^3 and 0.48g/cm^3 of the composite flours respectively. Increased percentage inclusion of 25%, 50% and 75% of cocoyam flour to wheat flour increased the swelling index values of the composite flours to 1.20, 1.33 and 1.59 respectively. Up to 50% inclusion of fermented and unfermented cocoyam flour produced acceptable cookies in terms of taste, crispiness, colour and overall acceptability. This paves way for enhanced utilization of cocoyam-wheat composite flour for the production of cookies.

References

Adane, M., Endale, A., Bultosa, G., Abdel-Mohsen, M.G. and Gebre-Mariam, T. (2006). Isolation and physicochemical characterization of Godare (*Colocasia esculenta*) starch from Ethiopia. *Ethiopian Pharmaceutical Journal*, 24: 13-22.

Agbelemoge, A. 2013. Utilization of Cocoyam in Rural households in South Western Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, 13(4):7944-7956.

Agunbiade, S. O. and Sanni, M. O. (2003). The effect of ambient temperature of cassava tubers on Starch quality. In: Proceedings of the Eight Triennial Symposium of the International Society for Tropical Root Crops, African Branch (ISTRC-AB-2003) Nov.12-14, 2003, IITA, Ibadan Nigeria. pp. 180-194.

AOAC (2000). Association of Official Analytical Chemists. Official Methods of Analysis. 17th ed. Horowitz, W. (ed.) 1 and 2, Maryland, USA.

Anankware J. P., Ojinnaka, M. C., Shadrrack, D. M. and Odinkemere-Davidson, V.N. (2018). Formulation, Proximate analysis and Quality Evaluation of Cocoyam-Wheat Cake Enriched with Edible Palm Larvae (Rhynchophorus phoenicis). *Acta Scientific Nutritional Health* 2(11): 19-25.

Aniedu, C. and Oti, E. (2008). Cassava based recipes. Extension bulletin of the National Root Crop Root Institute, Umudike, p.10.

Housson, P. and Ayenor, G. S. (2002). Appropriate processing and food functional properties of maize flour. *African Journal of Science and Technology*, 3(1):126-121.

Igbabul , B. D., Iorliam, B. M., and Umana, E. N. 2015. Physicochemical and sensory properties of cookies produced from composite flours of Wheat, Cocoyam and African Yam Beans. *Journal of Food Research*, 4(2): 87-95.

Ihekoronye, A. I. and Ngoddy, P. O. (1985). Integrated Food Science and Technology for the Tropics. London: Macmillan Publishers. Pp. 252-253.

Karuna, D., Noel, D. and Dilip, K. (1996). Food and Nutrition Bulletin, United Nations. 17(2).

Kulkarni, K. D., Govinden, N. and Kulkarni, D. (2008). Production and use of raw potato flour in Mauritian traditional foods. *Journal of Science, Food and Agriculture*, 17(2):162-168.

Lorenz, K. (1983). Protein fortification of Biscuits. *Cereal Foods World*, 28:449-452

Onimawo, A. I .and Akubor, P. I. (2005).“Food Chemistry”. Ambik Press Ltd. Benin City, Nigeria.

Onimawo, A. I., and Egbekun, K. M. (1998). Comprehensive Food Science and Nutrition (Revised Edition) pp 77.

Osungbaro, T. O., Jimoh, D. and Osundeyi, E. (2010). Functional and pasting properties of composite cassava-sorghum flour meals. *Agricultural Biology Journal, North America*, 1(4): 715-720.

Oti, E. and Akobundu, E. N. T. (2008). Potentials of cocoyam-soyabean-crayfish mixtures in complementary feeding. *Nigerian Agricultural Journal*, 39(2):137-145.

SAS (2003). SAS 9.1 Qualification Tools User's Guide SAS Institute Inc, Cary, N.C., USA.

Udensi, E. A. and Okoronkwo, K. A. (2006). "Effects of fermentation and germination on the physicochemical properties of *Mucuna cochinchinensis* protein isolate". *African Journal of Biotechnology*, 5(10): 896-900.

Table 1: Formulation of Cocoyam-Wheat Composite Flour for cookies production

Sample	Wheat Flour (%)	Fermented Cocoyam Flour (%)	Sample	Wheat Flour (%)	Unfermented Cocoyam Flour (%)
A	100	0	F	100	0
B	0	100	G	0	100
C	25	75	H	25	75
D	50	50	I	50	50
E	75	25	J	75	25

Table 2: Functional properties of Cocoyam- Wheat Composite Flours

Sample	Bulk Density (g/cm3)	Water Absorption Capacity (g/ml)	Oil Absorption Capacity (g/ml)	Swelling Index	Gelation Temperature (˚C)
A	0.62^{a}	1.95^{a}	1.25^{a}	1.20^{d}	81.00^{a}
B	0.46^{d}	1.86^{ab}	1.70^{a}	1.82^{a}	76.00^{c}
C	0.54^{c}	1.50^{bc}	1.75^{a}	1.33^{c}	81.00^{a}
D	0.60^{b}	2.00^{a}	1.15^{a}	1.20^{d}	78.25^{b}
E	0.43^{e}	1.45^{c}	1.15^{a}	1.60^{b}	78.00^{b}
F	0.62a	1.95^{b}	1.25^{b}	1.20^{e}	81.00^{a}
G	0.53^{b}	2.75^{a}	1.65^{b}	1.90^{a}	74.50^{c}
H	0.50^{c}	1.40^{c}	1.60^{b}	1.30^{d}	78.50^{b}
I	0.48^{d}	2.20^{b}	1.65^{b}	1.43^{c}	81.75^{a}
J	0.48^{d}	1.90^{b}	2.25^{a}	1.82^{b}	77.50^{b}

Means with same superscripts in same column indicate no significant difference (p<0.05).
KEY: A =100% Wheat Flour, B=100% Fermented Cocoyam Flour, C= 75% Wheat Flour, 25% Fermented Cocoyam Flour, D = 50% Wheat Flour, 50% Fermented Cocoyam Flour, E= 25% Wheat Flour, 75% Fermented Cocoyam Flour, F=100% Wheat Flour, G=100% Unfermented Cocoyam Flour, H= 75% Wheat Flour, 25% Unfermented Cocoyam Flour, I= 50% Wheat Flour, 50% Unfermented Cocoyam Flour, J= 25% Wheat Flour, 75% Unfermented Cocoyam Flour

Table 3: Sensory Evaluation of Wheat-Cocoyam Cookies

Sample	Taste	Crispiness	Colour	Overall Acceptability
A	7.40^{a}	6.75^{a}	7.80^{a}	7.35^{a}
B	5.40^{d}	5.90^{ab}	5.30^{c}	5.75^{b}
C	7.05^{ab}	6.25^{ab}	6.55^{b}	6.35^{b}
D	6.45^{bc}	6.65^{a}	5.60^{c}	6.35^{b}
E	5.60^{cd}	5.50^{b}	5.40^{c}	5.60^{b}
F	7.50^{a}	7.10^{a}	7.75^{a}	7.40^{a}
G	5.20^{b}	4.90^{b}	4.15^{c}	4.85^{b}
H	5.80^{b}	5.45^{b}	5.45^{b}	5.30^{b}
I	5.90^{b}	4.90^{b}	5.45^{b}	5.55^{b}
J	5.50^{b}	5.00^{b}	5.30^{b}	5.10^{b}

Means with same superscripts in same column indicate no significant difference (P<0.05).
KEY:A =100% Wheat Flour, B=100% Fermented Cocoyam Flour, C= 75% Wheat Flour, 25% Fermented Cocoyam Flour, D = 50% Wheat Flour, 50% Fermented Cocoyam Flour, E= 25% Wheat Flour, 75% Fermented Cocoyam Flour, F=100% Wheat Flour, G=100% Unfermented Cocoyam Flour, H= 75% Wheat Flour, 25% Unfermented Cocoyam Flour, I= 50% Wheat Flour, 50% Unfermented Cocoyam Flour, J= 25% Wheat Flour, 75% Unfermented Cocoyam Flour

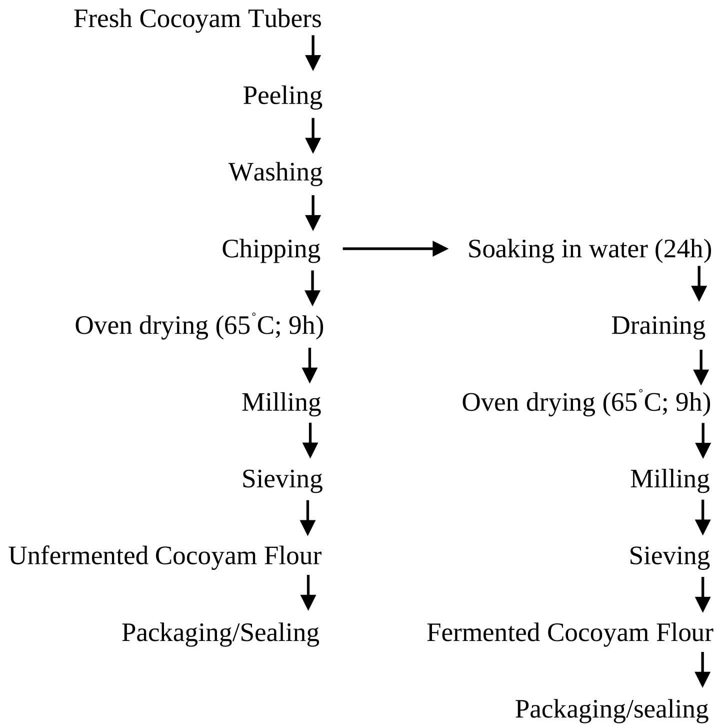

Figure 1: Flow chart for preparation of fermented and unfermented cocoyam flours